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Jerry Mack
Vice President
Commercial Airplanes
Washington, DC Operations

1200 Wilson Boulevard
Arlington, VA 22209

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FAA-01-10428-8

January 9, 2002

Docket **Management System**
U.S. Department of **Transportation Dockets**
Room **Plaza** 401
400 **Seventh Street SW**
Washington, **D.C. 20590-0001**

BOEING

Subject: FAR **121-344, Appendix M** Resolution Amendment **Request**

Reference: Boeing letter **B-H300-01-JGD-011**, J. Draxler to ARM-1, Office **of Rulemaking** , dated May **22, 2001**

Dear Sir/Madam:

Summary

The **purpose of this** letter **is** to **provide** additional information **and** clarification of **the** information **provided** in **the referenced letter. Boeing is** providing **this** information to **support** our **earlier request** for an **amendment to** the **FAR** 121.344, **Appendix M flight** data **recorder systems (FDRS) resolution** requirements to **allow three** Boeing **airplane models** to **record certain data parameters** using resolution requirements that differ slightly from the current regulation,

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Boeing **requested in** May **2001 an exemption** to **FAR 121.344, Appendix** M resolution **requirements** for **a total of** ten **parameters** on **three different** model **airplanes;** the **717,** the **757 and the** 767. **A detailed explanation of** the specific **parameters and the deviance in** the **existing resolution** from that required **in Appendix** M **is** provided in Attachment I to this letter.

Boeing **believes** that recording **of these parameters** using **the existing** resolution **does** not compromise the integrity of the signal **and should** not **hinder any** accident or incident **investigation. Use** of the **existing levels** of **parameter** resolution **will allow airlines** to use **their existing** installations and not require costly **system revisions that** will not provide **appreciable benefit.**

Analysis

Attachment I **to this letter outlines** the **difference** between the **existing recorded** resolution **of a** specific **parameter and** that required by **Appendix** M. Within **the attachment** both **the** direct and indirect **effects of the recorded** parameter **are provided.**

While Boeing recognizes that the level of recorded parameter resolution is used during accident investigations to determine whether small deviations from the steady state are real inputs, we also believe that the resolution concerns are neither large enough to result in appreciable change in airplane motion nor do they have a meaningful effect on the overall analysis of an accident.

For example, in the case of the 767 inboard aileron resolution requirement Boeing presently records to a resolution of 0.087 degrees, This resolution would result in the trailing edge of the aileron moving 0.0789 inches, which is less that the total thickness of the trailing edge that measures 0.1213 inch. The difference between the required and actual resolution being recorded at this time of 0.001 degrees corresponds to a total movement of the aileron trailing edge of only 0.0009 inch,

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In another example, although the present recorded vertical acceleration resolution of 0.004589 on the 717 exceeds the required resolution of 0.004 g, this difference is equivalent to an negligible error of 58 pounds in determining the weight of a 100,000 pound airplane. This slight deviation was an oversight during the initial design stages and when presented to the Los Angeles Airplane Certification Office in November 1998, an exemption to this specific requirement of FAR 121-344, Appendix M was granted.

Required Modifications

Changes required to the ten existing recorded parameters *to* meet the Appendix M resolution requirements would require redesigned components, changes to existing dataframes and new sensor installations. We estimate that these changes to the 65 affected 717 airplanes, 103 affected 757 airplanes, and 366 affected 767 airplanes presently operating under FAA authority would result in a total cost of approximately $38 million, The overall expense of modifying the total affected 76 model 717, 134 model 757 and *969* model 767 airplanes operating worldwide would be approximately $45 million. Boeing also estimates that redesign of the existing systems would require from six months to one year, with retrofit on affected airplanes requiring an additional one to two years.

Present Compliance

Excepting the 767 inboard aileron position and 717 vertical acceleration resolution, Boeing meets or exceeds the Appendix M range, accuracy, and resolution requirements on all newly delivered airplanes. In addition, excepting the resolution *of* the ten parameters outlined in Attachment I, Boeing presently has in place modifications that meet or exceed the range, accuracy, and resolution requirements of Appendix M for delivered airplanes

Boeing believes that the use of existing levels of recorded parameter resolution as outlined in Attachment I neither compromises the integrity of the recorded parameter nor will compromise any accident or incident investigation. Boeing also believes that requiring operators to modify the recording systems for these ten parameters in order to meet the requirements of FAR121.344, Appendix M would result in a costly retrofit with no appreciable benefit.

BOEING

Sincerely,

[redacted]

Jerry

Gerald R. Mack
Vice President, Safety and Technical Affairs
Boeing Commercial Airplanes

cc: Mr. Howard Swancy

Attachments:

Attachment I	717/757/767 FDRS Parameters – Resolution Impact Summary
Attachment II	767 Inboard Aileron Travel
Attachment III	717 Vertical Acceleration Resolution Issue

717/757/767 FDRS Parameters - Resolution Impact Summary

717 Parameters	Control Input:	Delta Resolution (Boeing - Required)	Update Rate	Airplane Free Response: Direct Effect: Delta Control Surface	Direct Effect: Delta Euler Rate (deg./sec.)	Indirect Effect: Delta Acceleration
5.Vertical Acceleration	(Not Applicable)	0.00058 (0.00458 - 0.004)	0.125 sec	N/A	N/A	0.00058 Nz

757 Parameters	Control Input: Baseline *(Large)* Control Displacement (light-mid. weight; aft CG, cruise condition)	Delta Resolution (Boeing - Required)	Update Rate	Airplane Free Response: Direct Effect: Delta Control Surface - Peak (deg.)	Direct Effect: Della Euler Rate - Peak (deg./sec.)	Indirect Effect: Delta Acceleration - Peak (g's)
12a. Control Column Position	*8.0775* degree push 9.923 degree pull	0.038 (0.082- 0.044)	0.5 sec	*0.086* 10.101 deg elevator	.003 / .009 pitch	0.0004 Nz
14a. Rudder Pedal Position	3.2nch input	0.028 (0.088 - *0.06)*	0.5 sec	0.011 deg rudder	.010 yaw, .058 roll	0.00036Ny
19. Stabilizer Position	1.1 degree Increment, leading *edge* up/down	0.022 (0.068 - 0.046)	1 sec		.075 / .046 pitch	0.0011 / 0.0002 Nz
23. Speedbrake Handle Position	70 degree input	0.196 (0.352- *0.*156)	1 sec	0.089 deg spoiler	.0116 roll	0.0009 Nz

767 Parameters	Control Input: Baseline *(Large)* Control Displacement (light-mid. weight; aft CG, cruise condition)	Delta Resolution (Boeing - Required)	Update Rate	Airplane Free Response: Direct Effect: Delta Control Surface - Peak (deg.)	Direct Effect: Delta Euler Rate - Peak (deg./sec.)	Indirect Effect: Delta Acceleration - Peak (g's)
12a. Control Column Position	*6.5* degree push 9.0 degree pull	0.049 (0.088 - 0.039)	0.5 sec	0.080 / 0.100 deg elevator	0.15 / 0.09 pitch	0.001 / 0.0008 Nz
14a. Rudder Pedal Position	*6.5* degree input	0.028 *(0-088- 0.06)*	0.5 sec	*0.016* deg rudder	0.012 yaw, 0.10 roll	0.0004 Ny
16. Aileron Position (Inboard)	18.314 degree input	0.001 *(0.087 - 0.086)*	0.5 sec		0.0011 roll	0.000004 Nz
19. Stabilizer Position	1.5 deg. increment, leading edge up / down	0.021 (0.064 - 0.043)	1 sec		0.06 / 0.04 pitch	0.021 / 0.0001 Nz
23. Speedbrake Handle Position	65 degree input	0.196 (0.352- 0.156)	1 sec	0.151 deg spoiler	0.005 pitch	0.0003 Nz

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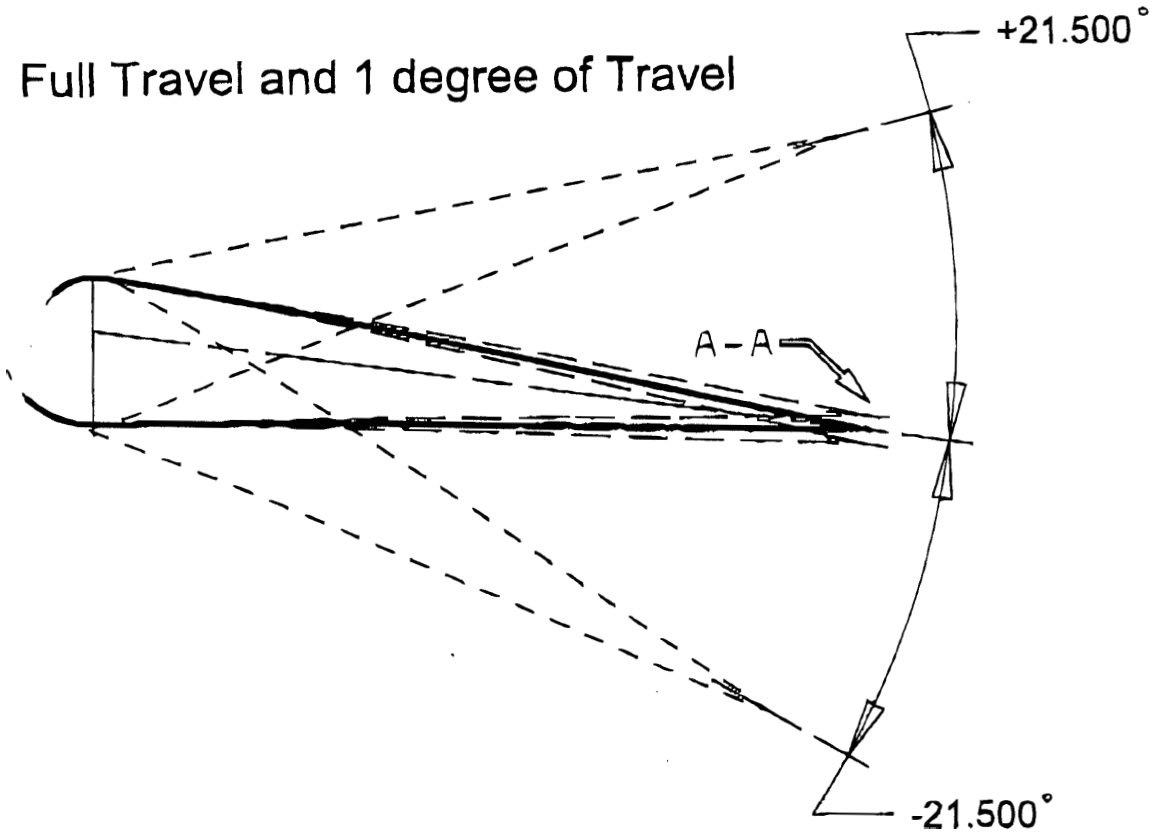
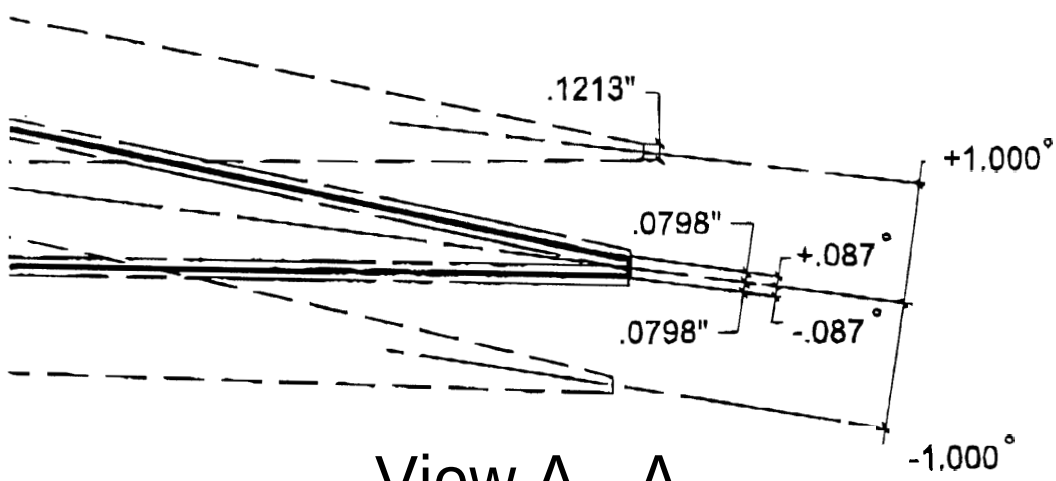
767 INBOARD AILERON TRAVEL





View A - A

The **smallest** amount of movement recorded (resolution) **is** .087 degrees. The required resolution **is** .2% **of** full range, which **equates to 086 degrees.** **The difference between the required and actual resolution, .001 degrees, would move the tip of the aileron .0009 inches.**

Vertical Acceleration Resolution Issue:

Vertical Acceleration **(Nz)** defines the relationship of Lift **to** Weight.
Nz = Lift/Weight

For **level flight,** Lift = Weight,
Hence Nz = 1.

Lift

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Weight (100,000 lbs.)

~~Resolution Increment~~ **~~Impact:~~**
Nz resolution **requirement** = .004g
Boeing resolution **capability** = .00458g
ΔNz = .00058g

For a 100,000**pound airplane,** ΔNz = .00058g is **equivalent to** 58 pounds **of** weight.

100 lbs.

Relating this **to a 100 pound person,** this **would be** equivalent **to** not knowing one's weight **to** within .058 **pounds** (less **than one ounce).**